MANAGEMENT PROBLEMS AND OPPORTUNITIES

The management objectives and strategies for the East Osage River Basin Watershed Inventory and Assessment were developed to address the problems and opportunities for conserving and enhancing the aquatic resources within the basin. The MDC Strategic Plan, the Fisheries Division Operational Plan, the Lake of the Ozarks Fisheries Management Plan, the MDC Stream Areas Program Plan, the MDC Stream Access Acquisition Plan, and the MDC West Central Regional Management Guidelines indicate areas of future expanded resource management, public awareness, and access needs, and helped guide development of these objectives and strategies.

The following text describes the management objectives and strategies under six major goals: water quantity and quality, habitat, biotic community, public access and recreational use, informational and educational opportunities, and data inventory and maintenance. Completion of these objectives will depend upon their status in overall Department, Division, and Regional priorities and the availability of personnel and funds. Many of the objectives rely on interagency coordination. Revision of any and all of these objectives will occur as needed. In particular, ongoing and future studies associated with the Federal Energy Regulatory Commission's relicensing of the Osage Project (Bagnell Dam) will provide substantial amounts of new information that will be used to evaluate and revise objectives.

GOAL I: PROTECT AND IMPROVE WATER QUANTITY AND QUALITY IN THE EAST OSAGE RIVER BASIN SO THAT ALL STREAMS ARE CAPABLE OF SUPPORTING NATIVE AQUATIC COMMUNITIES.

Status: Data were compiled for all known potential sources of water-related degradation in the basin. The beneficial uses and classifications of most third order and greater streams were evaluated, and numerous streams were recommended for upgraded classification in 1996 and 2001. Osage River discharge data were compiled from pre- and post-Bagnell Dam records maintained by the USGS. Information on discharge, river stage, water chemistry, water temperature, and aquatic communities is currently being collected and analyzed through contractual studies required of AmerenUE in the Federal Energy Regulatory Commission (FERC) relicensing process. Additional contractual studies and information are anticipated in 2002-2004, with a new Osage Project license scheduled to be issued in 2006.

Water Quantity

Objective I.1: Work with AmerenUE, USACE and other basin water regulators, during and following the FERC relicensing process, to improve aquatic habitat and recreational use by changing Osage Project operation to natural run-of-river (non-peaking) operation, or obtain mitigation measures which will result in equivalent or more benefits to natural resources and recreation.

Bagnell Dam

Problem/Opportunity: Bagnell Dam was constructed in 1931 for hydropower generation. AmerenUE operates the Osage Project plant under the auspices of the FERC, and the current license which expires in 2006. A new license is scheduled to be issued in 2006, and will be for at least a 30-year period. The Osage Project is a peaking plant with generation discharges usually occurring in the late morning through the evening, Monday- Friday, when power demand is at a peak. A minimum flow of about 455 cfs occurs 24 hours per day from a small "house" generator or turbine. The peaking operation creates rapid flow fluctuations, with low, drought-like flows followed by bankfull flows. As a result of the peaking and low flows, aquatic habitat and biota, and recreational use on the river have been negatively impacted. These impacts include: erosion of the river channel and islands, erosion and siltation of tributaries, loss of riparian habitat, channel widening and loss of depth at low flows - which strands aquatic life, sedimentation and loss of backwaters, changes in river flow that alter fish movement and spawning success, and cold water discharges from the lake that alter temperature and contain low levels of dissolved oxygen, and killing of fish going through the turbines (termed entrainment). Recreational use is affected by both low flows and high discharge rates, particularly the rapid changes in water levels and flow velocities. Fish kills have occurred due to low oxygen levels in the tailwater of Bagnell Dam. Some improvements have been made by cooperative efforts to increase oxygen by simple modifications in existing generation equipment and operational changes. However, DO still needs to be improved and other problems related to entrainment and fluctuating flows have not been adequately addressed. In addition, AmerenUE has requested amendments to the current license to upgrade four turbines. Increased discharge rates and potential problems with dissolved oxygen or entrainment of Lake of the Ozarks sport fishes must be addressed during the amendment comment period that is scheduled for late 2001 and early 2002. The relicensing process offers a rare opportunity to improve the Osage River for the next 30 years for fish, wildlife, and recreational use by balancing the need for hydro-power with the outstanding fisheries and tourism / recreational boon that Lake of the Ozarks offers. Guidelines can be developed to take advantage of opportunities to operate the dam in the best interests of Lake of the Ozarks, the Osage River, and the demand for power.

MDC should participate in the FERC relicensing effort by attending stakeholder and subcommittee meetings.

MDC should take the lead with other fish and wildlife and environmental agencies to work through the FERC relicensing effort under the 10J provision of the Federal Power Act to develop conditions to the new license which will develop Osage Project operations in ways which will enhance, protect, and mitigate for aquatic resources.

MDC should work with AmerenUE and other stakeholders to compare upgraded operation of the Osage Project with run-of-river (non-peaking) and other operational alternatives and evaluate effects on aquatic habitats and native aquatic and riparian communities. Measurement or modeling of habitat conditions and diversity provided by operational alternatives will be needed for comparing operational alternatives, as required by FERC in the relicensing of the Osage Plant.

MDC should inform other stakeholders of our vision for the continued

maintenance of the quality fishery and recreational / tourism offered by Lake of the Ozarks and the improvement of the Osage River offered during and following the relicensing period.

Stream Teams and other stakeholders should be encouraged to adopt streams in the basin particularly below Bagnell Dam to help with monitoring biota, water quality, and habitat.

MDC should provide guidance in the development of standardized sampling methods for fish and macroinvertebrates and mussels in the Osage River to document improvements in habitat as changes in operation of Bagnell Dam are implemented under the new license. MDC should seek mitigation for habitat losses along MDC areas along the river and tributary streams impacted by the operation of Bagnell Dam.

MDC should provide guidance in the monitoring of entrainment of fish through Bagnell Dam with the upgrades of any new turbines.

MDC should provide guidance in the monitoring of discharge from Bagnell Dam to ensure that minimum flows and other flow regime changes are followed as outlined in the FERC license to be issued in 2006. Report violations of the license to AmerenUE, FERC, MDNR, and the Public Service Commission.

Objective I.2: Support the enactment of a State Water Law and other rules that will prevent negative downstream impacts from single or cumulative withdrawals.

Problem/Opportunity: Since there are inadequate water-use policies in Missouri, downstream users and government agencies have little recourse to regulate upstream water users and prevent them from withdrawing water that may impact aquatic organisms.

Cooperate with and support MDNR in preparing a Missouri Water Policy which restricts water removal from streams for upstream uses.

Work with MDNR and USACE, to protect or enhance stream flows through oversight and enforcement of existing water withdrawal permits.

Work with federal/state entities toward interstate compact.

Water Quality

Bagnell Dam

Problems and Opportunities: Low dissolved oxygen and rapid temperature changes are common below Bagnell Dam. Some improvements have been made by AmerenUE in cooperative efforts to increase oxygen by simple modifications in existing generation equipment and operational changes. Additional improvements are possible with new technologies and with the turbine upgrades described in the water quantity objectives section. Low temperatures may be a continual problem as the depth of the intake structure on Bagnell Dam is below the thermocline and cold water discharged from the lake during the summer when LOZ is thermally stratified can impact fish and mussels.

Recommend potential changes in the operation of Bagnell Dam during the FERC relicensing to increase dissolved oxygen and moderate temperature changes in the Osage River. Data for these changes will be forthcoming in the contractual water quality sampling and analysis slated for 2002 and 2003 by AmerenUE. Modeling of the water quality conditions using the collected data would be beneficial under the 401 certification required by MDNR and for comparing operational alternatives, as required by FERC in the relicensing of the Osage Plant.

MDC should continue to work with AmerenUE to monitor dissolved oxygen levels with the new turbine upgrades.

Pollution Sources

Objective I.3: Continue to identify potential pollution sources within the basin and within the recharge areas of springs; evaluate their potential impacts on water quality and aquatic communities, and implement management strategies to monitor the potential impacts and reduce these threats.

Sewage Treatment Plants

Problem/Opportunity: Sewage treatment facilities of the Lebanon WWTP are chronically discharging poorly treated wastewater to the basin.

Encourage MDNR to monitor compliance with permit limitations, and comment on plans to upgrade

these facilities.

Ensure that receiving streams are appropriately classified for protection of aquatic resources.

Encourage Stream Teams to monitor sites below these facilities.

Sludge Application

Problem/Opportunity: Wastewater sludge stored in lagoons or applied to farmland can pose a threat to water quality. Application sites for sludge storage seem to be adequately monitored by the MDNR and 18 problems have been reported in the basin. Private haulers have only recently been required to obtain licenses and file reports, so limited information is available. There are a large number of private treatment systems in the basin, especially around LOZ, that depend on private haulers for sludge disposal. Locations of disposal sites within the watershed need to be determined.

Obtain records for private haulers from MDNR, create a database, and plot sites on 7.5 minute topographic maps.

Obtain annual reports each year and evaluate whether haulers are in compliance.

Non-POTWs (Non-public owned treatment works)

Problem/Opportunity: There are large numbers of these systems in the LOZ area that handle considerable amounts of waste. They pose a significant threat to water quality if they are not monitored and properly maintained. The number of these systems is expected to increase with continuing development around the lake because many sites will not meet the requirements of the new regulations for conventional septic systems.

Recommend strict permit review and compliance monitoring for these facilities by MDNR.

Animal Waste Point Source

Problem/Opportunity: Most of the permitted animal waste facilities in the watershed are hog confinement facilities. However, there are at least 14 large poultry operations and eight dairies within the basin.

Encourage Stream Teams to monitor water quality and aquatic communities in the receiving streams below large facilities.

Support legislation that reduces potential pollution of

the surface and groundwater resources from the application of poultry, hog, and cattle waste.

Landfills

Problem/Opportunity: The Lebanon Sanitary Landfill occasionally discharges leachate to Goodwin Hollow, a losing stream that is hydrologically connected to Niangua Darter habitat in the adjacent subbasin.

Recommend that the MDNR inspect this facility, and ensure maximum water quality protection.

Agricultural Runoff

Problem/Opportunity: Wastewater of greater than 300 animal units from dairies and hog and poultry confinement facilities and dairies are regulated by the MDNR as point sources. They must meet minimum standards, and operations within the watershed appear to be gradually coming into compliance. Livestock in pasture are non-point sources that are less tangible and may represent a considerable source of contaminants. The amount of stream contamination can be reduced by good pasture management, erosion control, and providing filter strips in riparian corridors.

Promote good pasture management, erosion control, revegetation of corridors, and livestock exclusion throughout the watershed.

Cooperate with NRCS to implement alternative water systems incentive agreements throughout the watershed.

Utilize other state and cost share programs such as AgNPS, EQIP, WHIP, and CRP to address non-point agriculture pollution problems in the watershed.

Water Quality Monitoring

Objective I.4: Ensure that water quality and aquatic communities are monitored adequately to provide early detection of stream and lake degradation and to evaluate possible effects of watershed and stream improvement projects.

Problem/Opportunity:

Support continued water quality monitoring efforts in the Wet Glaize, Tavern Creek, Little Maries River, Lower Maries River, Lower Osage River, Miller County Osage River Hills, Gravois Mills, Cole Camp Creek, Turkey Creek, and Dry Auglaize Creek Subbasins to document improvements from animal waste treatment facilities and from continuing efforts to reduce agricultural runoff.

Encourage Stream Teams to adopt strategic sampling sites in the basin.

Fish Kills

Problem/Opportunity: Several fish kills have been documented in the basin. Most have been associated with either the operation of Harry S Truman Dam and Bagnell Dam or sewage discharge from a number of municipal and non-municipal sources sewage treatment facilities within the basin.

Assist state and federal agencies with enforcement of water pollution laws by cooperating with pollution and fishkill investigations.

Cooperate with the Truman Project Office of the USACE to set spillway outflow limits and turbine use guidelines and minimize releases harmful fish below Truman Dam.

Cooperate with MDNR to minimize future threats from Truman Dam or Bagnell Dam due to the addition of new turbines or discharge manipulation.

Cooperate with MDNR to minimize future threats from municipal and non-municipal sewage treatment plants within the watershed and spring recharge areas.

Fish Contamination

Problem/Opportunity: During the previous sample periods, largemouth bass collected from the basin have shown elevated levels of mercury.

Continue to collect fish for contaminant and heavy metal analysis by MDOH from Lake of the Ozarks and selected tributary streams every year per MDOH guidelines.

Cooperate with MDOH in informing the public about health advisories and the impacts of fish contamination.

Fish Contaminant Sampling

Problem/ Opportunity: MDC cooperates with the MDOH to sample fish for contaminant and heavy metals in public waters around the state. Increases in the heavy metal mercury have occurred in waters in the basin. In addition, recent changes related to fish advisory levels for mercury were adopted by EPA. In June 2001 a statewide advisory was issued for all waters for pregnant or nursing women, and children under the age of 12 who eat largemouth bass greater than 12 inches.

Beneficial Use Attainment

Objective I.5: Evaluate all classified streams to ensure that appropriate beneficial uses are being attained and recommend upgraded classifications as necessary.

Problem/Opportunity: Some third-order streams in the watershed remain unclassified.

Identify appropriate classifications and beneficial uses for remaining unclassified streams and recommend upgraded classification to MDNR.

Problem/Opportunity: Efforts to protect Niangua darter habitat with a special classification have failed to win Clean Water Commission approval. Classification could be used to require stricter limitations in NPDES Permits that discharge to streams within critical habitat. "Outstanding State Resource" classification would also provide better protection for these streams.

Propose, once again, that Niangua darter known range be given special classification "Critical Habitat for Rare and Endangered Aquatic Species," or alternatively, "Outstanding State Resource."

Objective I.6: Promote programs that enhance groundwater recharge in the watershed and spring recharge areas.

Springs

Problem/Opportunity: Springs are the main source of sustained flow in streams during periods of low precipitation. Since aquatic communities can experience

great stress under these conditions (low dissolved oxygen and high temperatures), adequate flow and good water quality are essential. Springs in the watershed have not been monitored sufficiently to determine current conditions or detect change over time.

Compile existing data on springs within the watershed.

Cooperate with the USGS and MDNR to develop a plan to monitor strategic springs.

Watershed Projects

Problem/Opportunity: The amount of rainfall that percolates through the soil to recharge aquifers and maintain base flows is affected by land use and the amount of vegetation. Ungrazed, uneven-aged, woodland allows optimal percolation, and well-managed pastures improve the quality of runoff events.

Promote watershed practices that improve groundwater recharge, including cattle exclusion from woodlands, good pasture management, timber stand improvement, and conversion of pasture and open fields to woodland.

Support current and future Special Area Land Treatment Projects (SALT) as administered by the county Soil and Water Conservation Districts and the Missouri Department of Natural Resources.

GOAL II: PROTECT AND IMPROVE AQUATIC HABITAT CONDITIONS OF THE EAST OSAGE RIVER BASIN WATERSHED TO MEET THE NEEDS OF NATIVE AQUATIC SPECIES WHILE ACCOMMODATING SOCIETY'S DEMANDS FOR WATER AND AGRICULTURAL PRODUCTION.

Objective II.1: Ensure that instream projects within the watershed do not interfere with natural stream processes.

Osage Lock and Dam at RM 12.1

Problem / Opportunity: During the late 1890's the USACE developed a navigation plan to improve the Osage River for barge traffic. In this plan the USACE identified a series of Lock and Dams to be constructed at various intervals along the entire stretch of the Osage River. Only one lock and dam was constructed in the early 1900's by the USACE at RM 12.1. This lock and dam now has the lock removed but the dam serves as an impediment to fish migration during some parts of the year. When the Missouri River is low and no generation occurs, fish cannot get over the dam, or if the Missouri River is low and generation flows are not high enough to over top the lock and dam, the

velocities in the narrow opening to the lock exceed the swimming ability of many sportfish, preventing them from migrating upstream. The Osage Lock and Dam is currently under private ownership as the USACE deeded the property back to the landowner. The lock and dam also presents a hazard to boaters and canoeists. A large amount of gravel and silt is present above the dam.

Work with the landowner who owns the land where the Osage Lock and Dam is located and federal and other state agencies to investigate the feasibility of modifying the existing structure to improve the passage of fish at a variety of river flows and reduce hazards to recreational users.

Work with AmerenUE in the FERC relicensing to evaluate Osage Project operational alternatives that would improve fish passage during fish and mussel spawning seasons

Channel Alterations

Problem/Opportunity: Many landowners and county and city governments still believe that channelization is an appropriate solution to bank erosion and flooding problems. Although some short-term reduction in bank erosion may be achieved, the negative side effects can be severe, including loss of habitat diversity, accelerated upstream and downstream erosion, headcutting upstream, and channel destabilization.

Meet with landowners and local government officials who propose channelization projects to discuss their concerns and inform them about stream processes and the negative impacts of channel alterations, and recommend more appropriate remedies.

Disseminate MDC literature and other information that describe alternative techniques to channelization.

404 Activities

Problem/Opportunity: A large number of Section 404 applications for instream construction and excavation are submitted for streams within basin.

Review all 404, gravel excavation, bridge construction and other development projects that may impact streams and recommend appropriate action to maintain, improve or protect aquatic habitats.

Recommend denial of 404 permits that require repeated stream crossing or recommend conditions that include installation of a temporary crossing under MDC supervision.

Encourage Stream Teams to comment on 404 permits.

Problem/Opportunity: The permitting process for sand and gravel removal has become greatly simplified within recent years. The simplification of the application and approval process for applicants has reduced a very important component which has been beneficial in the past - direct contact between landowners or permittees and government employees from MDC, USACE, or MDNR. These contacts provided opportunities to inform the interested parties about stream processes and the meaning and justification for the permit conditions; learn about their experiences, techniques, and concerns; and otherwise establish a cooperative, mutually beneficial relationship. In addition, greater involvement by USACE, MDNR, or MDC employees provided opportunity to make site visits and document pre-permit conditions, monitor compliance, and observe possible impacts. Now, when a general permit is issued, the MDC is usually not consulted and frequently the USACE makes no site inspection. Nationwide permits are usually issued with inadequate conditions to protect aquatic resources and without MDC input.

Review 404 applications and inspect proposed sites whenever possible.

Encourage the USACE to provide opportunities for regional fisheries personnel to comment on 404 applications that include requests for variances, crossing streams, or channelizations.

Recommend that MDC Policy Coordination request changes in procedures to USACE General and Nationwide Permits. Include careful scrutiny of locations of proposed activities, onsite inspections where violations have occurred, and MDC notification of proposed activities.

Recommend that MDC Policy Coordination continue to work with the Clean Water Commission and MDNR to control gravel mining through 401 certification.

Objective II.2: Determine flows necessary to sustain native communities of fish and other aquatic life, and to provide adequate spawning habitat for white bass, walleye, and other species.

Problem/Opportunity: Truman Dam prevents migration of LOZ white bass,

walleye, paddlefish and other species to historic spawning sites upstream. White bass spawn below Truman Dam and Bagnell Dam on the Osage River. While some walleye may spawn below Truman Dam, the contribution to the LOZ fishery is speculative. Sauger are found in the Osage River below Bagnell Dam. Suitable spawning conditions for paddlefish are not available below Truman Dam. Spawning areas for paddlefish below Bagnell Dam are useless.

Provide guidance in the development of fish sampling and spawning habitat assessment techniques on the Osage River for walleye and sauger.

Develop recommendations for maintaining adequate flows below hydropower dams for white bass, walleye, sauger, and paddlefish using approved instream flow methodologies as recommended by Fisheries personnel. Such flows might also enhance paddlefish migration and susceptibility to anglers on the Osage River and Upper Lake of the Ozarks.

Objective II.3: Implement habitat improvement projects on public and private land.

Habitat Improvement Projects on Private Land

Problem/Opportunity: Riparian corridors are in poor condition on many watershed streams and cattle frequently have access to corridors and streams. The vast majority of stream frontage in the watershed is in private ownership.

Implement landowner incentive programs through existing or new state or federal incentive program or assist county SWCDs to obtain federal or state grant money through: 319 Environmental Protection Agency grants, Rural Clean Water Program, Water Quality Improvement Practices (WQIP), AgNPS projects and MDC stream private land programs.

Develop landowner cooperative projects (LCPs) in the basin. Target Maries River and Tavern Creek for promoting cost shares.

Promote the adoption of streambank erosion control and riparian corridor establishment or protection practices for approval by the county Agriculture Executive Committee of FSA or the SWCD administered through the MDNR Soil and Water Conservation Program.

Encourage landowners and urban residents to form watershed committees.

Provide technical assistance and information to all landowners who request assistance and on-site consultation to those willing to establish and maintain stream corridors guidelines.

Problem/Opportunity: Promotional and educational efforts are necessary to inform landowners about cost-share programs and encourage participation.

Promote and advertise stream improvement projects on Department areas and LCPs for demonstration purposes using Neighbor to Neighbor or SWCD Field Day events.

Advertise and promote available stream habitat improvement cost-share programs through traditional and agricultural media; emphasize word-of-mouth advertising by neighbors.

Sponsor a stream and watershed workshop for landowners, NRCS, FSA, USACE, and city and county officials which highlights problems and strategies for correcting them.

Increase landowner awareness of MDC private stream programs through SWCD and Farm Bureau cooperative programs at the county level. Emphasize the economic benefits of well-managed streams.

Cooperate with the MDC Outreach and Education Division to develop stream habitat improvement materials for use by local Vocational Agricultural instructors, FFA chapters, and 4-H clubs.

Habitat Improvement Projects on Public Lands

Problem/Opportunity: Area Plans are prepared periodically for MDC conservation areas.

Inspect these areas and recommend corridor expansion or bank stabilization projects as necessary to correct problems and serve as demonstrations sites.

Include monitoring and habitat improvement strategies for streams on these areas to correct problems.

Problem/Opportunity: The Saline Valley Conservation Area provides an excellent opportunity for managing aquatic resources.

Inspect this area and recommend corridor expansion, bank stabilization

projects, and fish habitat improvements to correct problems and serve as demonstrations sites.

Problem/Opportunity: Develop habitat improvement projects as demonstration areas on selected MDC lands in the basin.

Develop several stream demonstration areas in the basin.

Continue to monitor these projects and complete maintenance as necessary.

Use these projects to demonstrate good stream management to the general public and agency personnel as appropriate.

Unique Habitat

Objective II.4: Identify and protect unique habitat in the watershed

Problem/Opportunity: Very little high quality bottomland forest was identified in the Natural Features Inventory of the basin. This is the result of one or more of the following common practices: clearing of bottomlands up to the stream edge; allowing cattle to graze the intact forests; and repeated logging of forests and excessive erosion along the Osage River from Bagnell Dam discharges. These forests are important and necessary components of the stream ecosystem. They provide essential habitat, help prevent streambank erosion, filter surface runoff and groundwater flow, reduce water temperatures by shading streams, and contribute woody debris and organic matter.

Encourage landowners in the basin with bottomland forests or sites naturally suited for bottomland forests to protect and manage them.

Encourage AmerenUE to work with landowners along the Osage River to mitigate for land lost as a result of discharges from Bagnell Dam. (Note that MDC is also a landowner along the river.)

Protect the remaining bottomland hardwoods and look for ways of establishing bottomland hardwoods on MDC's Saline Valley, Smokey Waters and other MDC CAs.

Problem/Opportunity: Very few high quality wetlands were identified in the Natural Features Inventory. Wetlands were probably always a scarce resource in the watershed historically and many have been developed for pasture or cropland or suffered from changes in hydrology resulting from downcutting of the streambed of the Osage River due to releases from Bagnell Dam.

Identify, protect, and enhance wetland habitat through purchases, easements, or other agreements.

Recommend wetland creation at suitable sites on public lands.

Implement management strategies outlined in the MDC Guidelines for Promoting Fishery Resources in Missouri Wetlands on all public areas and privately owned wetlands. Assist the West Central Region Wildlife personnel with workshops for other agency staff and landowners on the importance of managing wetlands for fish and other aquatic organisms.

Assist MDC West Central Region personnel with workshops for loggers and landowners regarding proper methods of logging timber from riparian corridors and bottomland forests.

Problem/Opportunity: Two of the eight extant Niangua darter populations occur in the watershed. Habitat degradation is apparently still negatively impacting the Niangua darter. Nutrification and sedimentation are believed to be the most serious threats to the darter, as well as the rest of the natural fauna.

Support continued habitat and water quality monitoring efforts in the Lower Maries River, Upper Maries River, Little Maries River, and Tavern Creek subbasins.

Encourage Stream Teams to adopt monitoring sites in Niangua darter range.

Identify, protect, and enhance Niangua darter habitat through purchases, easements, or other agreements.

Habitat Assessment

Objective II.5: Inventory aquatic habitat throughout the basin to provide descriptions of habitat conditions in representative reaches, and quantify various parameters to allow for comparisons between subbasins and with other Missouri watersheds.

Problem/Opportunity: Insufficient numbers of SHADs were conducted to adequately characterize the entire watershed. Most of the SHADs were completed during the 1990's, so it would be desirable to repeat them if surveys are conducted at additional sites. The Habitat Assessment Committee investigated possible alternatives to the SHAD that would provide more useful quantitative data from a watershed wide perspective. Analyses of remote sensing data, including aerial photography, digital orthophotography, and satellite imagery, are promising alternatives, however, current data on a sufficiently large scale is not readily available. A method for evaluating riparian corridors has been developed by several MDC personnel using aerial photographs, aerial videos, and other methods. Photographs were on hand for only a small portion of the watershed, so this method was not pursued for this plan.

Another emerging method is digital image analysis of high quality helicopter videos or low altitude digital photographs.

Implement the current habitat assessment methodology within the watershed.

Incorporate site specific habitat observations on all Niangua darter snorkeling trips as determined from criteria developed by MDC's Rare Threatened & Endangered Species Fisheries Biologist.

GOAL III. MAINTAIN THE DIVERSITY AND ABUNDANCE OF AQUATIC COMMUNITIES AND IMPROVE THE QUALITY OF THE SPORT FISHERY.

Objective III.1: Protect and improve the status of threatened and endangered species, and implement state or federal recovery plans.

Problem/Opportunity: Niangua darter populations appear to be fairly stable in the Maries River but declining in Tavern Creek. Sampling in both subbasins needs to be expanded and compared to Mattingly's (UMC) sampling. No thorough, comparable survey has been conducted throughout Niangua darter range since Pflieger's in the 1970s and recent sampling procedures have been inconsistent.

Conduct a thorough search of the Upper Maries, Lower Maries, Little Maries, and Tavern Creek subbasins for the Niangua darters distribution.

Recommend to the MDNR that all known range of the Niangua darter be classified as "Critical Habitat for Rare and Endangered Aquatic Species," or failing that, as "State Outstanding Resource Waters."

Conduct a multi-district survey of known range to evaluate current status and consider elevation of federal status to "Endangered."

Target the Lower Maries River, Upper Maries River, Little Maries River, and Tavern Creek subbasins for intensive promotion of stream incentive programs and SSA.

Identify, protect, and enhance Niangua darter habitat through purchases, easements, and cost shares. Highlight expansion priorities of MDC area plans as they are developed.

Carry out recommendations in the Niangua Darter Recovery Plan and actively participate on the Niangua Darter Recovery Team.

Adopt a standardized monitoring plan for Niangua darters and maintain a statewide database.

Sturgeon

Problems and Opportunities: Lake sturgeon and shovelnose sturgeon have historically been found in the basin (Pflieger 1970). Lake sturgeon have been documented by MDC biologists from both Lake of the Ozarks and below Bagnell Dam as late as 1998 (Stoner 2000). Opportunities may exist for managing this species in the Osage River below Bagnell Dam (MDC Lake Sturgeon Plan 1992).

Conduct standardized sampling for sturgeon in the Osage River below Bagnell Dam as outlined in the MDC Monitoring Evaluation Study (Gemming, 2001).

Determine suitable habitat and river flows that are conducive to spawning success for lake and shovelnose sturgeon, and recommend these flows be discharged from Bagnell Dam during the spawning season.

Sauger / Walleye

Problems and Opportunities: Sauger are primarily found in the Mississippi and Missouri rivers, however, sauger are frequently caught by anglers in the Osage River below Bagnell Dam. Several state record sauger from the Osage River have been recorded in the past ten years. Walleye are found in the Osage River, Lake of the Ozarks and some of the tributary streams. Walleye and sauger are frequently found below the Lock and Dam on the Osage River. Opportunities exist for managing these two species in the Osage River. Continuous water flow is needed to stimulate walleye gonadal development as determined in an MDC study conducted below Truman Dam (DiStefano 1994).

Provide guidance in the development of sampling techniques for sauger in the Osage River during late January thru early March as sauger spawn at cooler water temperatures than walleye.

Provide guidance in the development of management strategies for these two species such as recommending water flows for Bagnell Dam that enhance spawning habitat and gonadal development of mature adults and harvest regulations as needed.

Problem/Opportunity: Thorough fish community samples have not been conducted in all subbasins of the East Osage River Basin.

Conduct periodic, thorough fish community sampling at historic collection sites as well as new sites for subbasins which have not historically been well sampled.

Problem/Opportunity: Comprehensive invertebrate sampling has not been conducted in the basin. Sampling is scheduled for summer and fall 2001 on the Osage River in conjunction with the FERC relicensing of Bagnell Dam.

Encourage Stream Teams to assist with sampling.

Problem/Opportunity: A diverse mussel community historically occupied the basin. In consideration of mussel decline throughout the Midwest and the lack of recent watershed sampling, a thorough mussel survey is warranted.

Mussels

Evaluate the results of the mussel survey planned by AmerenUE in conjunction with FERC relicensing and recommend periodic sampling be conducted as required.

Special considerations should be given to the federally endangered pink mucket and efforts made to restore it to its original habitat.

Problem/Opportunity: All subbasins offer opportunities for producing high quality fisheries.

Identify and prioritize the native sportfish most suitable for increased management and implement a plan for sampling.

Develop strategies for managing selected sportfish species such as: paddlefish, walleye, sauger, smallmouth bass and catfish on the Osage River and tributary streams.

Assess the impacts to sportfish of Truman Dam and Bagnell Dam operations and to Lake of the Ozarks and streams within the basin.

Problem/Opportunity: Management actions targeting one or more game species can have unexpected negative impacts on non-game fishes and invertebrates. Several listed rare, threatened, and endangered species are found in limited number in the watershed.

Evaluate the potential impacts of sportfish management activities on non-game fishes and invertebrates before and after implementation.

Avoid special management areas in designated critical habitat for state or federally listed rare, threatened or endangered species.

Problem/Opportunity: All tributaries streams are important components of the fisheries and aquatic ecosystems of the basin.

Implement all strategies of the LOZ Management Plan and this plan so they compliment one another.

Be aware of problems which arise in the Osage River and LOZ which may negatively impact the basin (exotic species introductions; distributional changes of zebra mussels, bighead carp, black carp, or spined water fleas; etc.)

GOAL IV. INCREASE ACCESS AND MDC OWNERSHIP WITHIN THE EAST OSAGE RIVER BASIN.

Objective IV.1: Provide additional MDC owned access to the Osage.

Problem/Opportunity: There is a demand for at least one stream access on the Lower Osage River to increase user convenience and encourage more uniform use throughout the basin.

Priority should be given to land acquisitions in the basin that include stream frontage for access development and corridor protection/development.

Objective IV.2: Enhance accessibility at all MDC access and frontage areas within the watershed.

Problem/Opportunity: Area Plans have been or are being developed for five stream areas. There are no disabled user facilities at MDC stream areas in the watershed.

Include public use objectives, including some disabled user facilities, in MDC area plans for public lands along streams in the

basin.

Objective IV.3: Implement expansion plans as outlined in MDC area plans; focus on key expansions at Saline Valley, CA and Smokey Waters, CA.

Problem/Opportunity: Area Plans have been or are being developed for several stream areas.

Highlight expansion needs and stress the need to fund these expansion areas.

Objective IV.4: Work with other divisions and agencies to address problems associated with increased public use in the basin.

Work with other divisions to minimize vandalism and improper public use of MDC areas by improving designs and patrolling areas during heavy public use periods.

GOAL V: ADDRESS INFORMATIONAL AND EDUCATIONAL OPPORTUNITIES WITHIN THE EAST OSAGE RIVER BASIN.

Objective V.1: Inform other agencies, local government officials, land developers, landowners, and the general public of water quantity and quality conditions and problems in the watershed.

Problem/Opportunity: Sound watershed management depends on our ability to increase public awareness and educate the general public, landowners, city and county officials, and industrial and residential developers on the importance of improving water quality, and generate an interest in water quantity and quality problems and solutions.

Include the basin as a high priority for private landowner assistance within the West Central Region Private Land Plan.

Coordinate private landowner assistance with Agricultural Services, NRCS, FSA, The Nature Conservancy, USACE and MDNR to cultivate mutual interests and concerns for land and stewardship issues.

Incorporate information on Best Management Practices into MDC stream management workshops presented to local SWCDs, private industry, city and county governments and other agencies.

Attend public meetings regarding highway construction, development projects, 404 permits, and state or federal watershed projects to inform the public about local water quantity and quality and watershed issues and the importance of reporting all pollution incidents to the MDNR and MDC.

Write articles for local newspapers, Farm Bureau, University Extension, local SWCD, NRCS, and FSA newsletters, and conduct

radio or TV programs concerning proper land use and local water quantity and quality problems and solutions.

Work with MDC Outreach & Education Consultants to incorporate information into teacher workshops concerning watershed and stream issues, particularly the need to promote advocacy of these resources and the importance of local citizen involvement to solve local problems by forming Stream Teams.

Seek opportunities to involve citizens and organizations in planning activities.

Publicize the acquisition, development and opening of new public access sites.

Promote the adoption of watershed streams by Stream Teams.

Promote the education of youth in the watershed by coordinating aquatic education opportunities for schools in the watershed with MDC Outreach & Education Consultants.

Write a Missouri Conservationist article on the Osage River.

Produce a video promoting the resources and public use opportunities, and stream ecology and preservation in the watershed.

Emphasize stream ecology, good stream stewardship and the MDC Streams for the Future program (using watershed models and the stream trailer where applicable) during presentations at adult and youth organizations, adult service clubs and sportsman's groups, Boy Scouts of America, Girl Scouts of America, Future Farmers of America, 4-H and Vo Ag youth groups, schools in the watershed, and fairs or other special events.

Promote stream ecology in MDNR (Ha Ha Tonka, Bennett Spring, LOZ state parks) and Wilmore Lodge brochures and at their visitor centers.

Promote the development of a River Learning Center to educate the public on river hydrology and the effects of current land use practices.

Promote the adoption of this plan by the Missouri Department of Natural Resources Non-point Pollution Program responsible for writing watershed plans for the state of Missouri.

> Include questions on water quality, water quantity, habitat conditions, biotic community access and public awareness

issues in telephone or mail surveys to the public residing in the watershed.

Incorporate these goals and objectives into the Regional Management Guidelines.

Enhance awareness among all resource and government agencies by providing copies of this inventory and assessment to MDNR offices at LOZ state parks; U.S. Army Corps of Engineers in Kansas City and the project office in Warsaw; the USFWS office in Columbia; SWCD, NRCS and FSA offices in Benton, Camden, Hickory, Laclede, Miller, Osage, Maries, Cole, Pulaski, and Morgan counties; MDC employees who work in the basin; Environmental Protection Agency, The Nature Conservancy, USGS, city and county officials, state and federal legislators, AmerenUE, and county libraries.

Provide copies of this plan to Stream Teams within the basin as requested.

Keep Stream Teams informed about water quality problems and other significant stream issues.

Include this inventory and assessment on the MDC watershed web page.

GOAL VI. MANAGE THE EAST OSAGE RIVER BASIN DATABASES TO PROVIDE ACCURATE AND UP-TO-DATE DATA, EASY ACCESSIBILITY, AND COMPATIBILITY WITH OTHER REGIONS, DIVISIONS, AND AGENCIES.

Objective VI.1: Organize watershed databases to improve accessibility and compatibility.

Problem/Opportunity: Numerous databases were created and a large amount of data were compiled during the inventory for this plan. These databases must be readily accessible for general use and updating. They should also be compatible with those of other regions, divisions, and agencies to facilitate exchange of data.

Prepare documentation for all watershed databases.

Ensure that watershed databases are compatible with comparable statewide databases.

Incorporate these data into MoRAP and the Statewide Resource Assessment and Monitoring Plan.

Objective VI.2: Update watershed databases periodically to include the most current, accurate information.

Problem/Opportunity: Many of the watershed databases must be updated periodically to include the most recent data (e.g., 404 permits, fish collections). MoRAP is coordinating data preparation and maintenance of some databases throughout the state to increase compatibility and efficiency.

Develop a plan for updating watershed databases periodically.

Cooperate with MoRAP to improve database compatibility between agencies.

Incorporate all data collected by AmerenUE during the FERC relicensing process into the MoRAP database and appropriate items in MDC's Natural Heritage Database.